case is not nearly so bad as it is in regard to the beginning of spring. The astronomer who, for most of his work, prefers the clearest skies and the darkest hours, says twilight ends only with the last trace of scattered sunlight in the western heavens. On clear nights, the only kind in which he is interested, this last glimmer disappears when the center of the sun is about 18 degrees below the horizon. This does not suit the average person who considers twilight to end as soon as it gets too dark for people to go about their ordinary outdoor occupations. On clear evenings this occurs when the center of the sun is about 6° below the horizon, or in about one-third the time from sundown to the end of astronomical twilight. On cloudy evenings twilight, in this work-a-day sense, ends much sooner, but there is no fixed time for it—the term is vague and often confusing.

Light and dark of the moon.—Whoever follows the foolish occupation of moon-farming, of planting things that fruit above the ground in the light of the moon, and tubers that grow under the soil in the dark of the moon, is confronted with the puzzling necessity of knowing just when it is light of the moon and when dark. And the more he tries to be certain of the matter the more confused he is likely to become. Some will tell him that dark of the moon is that brief time, three or four days, before new moon when it is not seen at all owing to its nearness to the sun, and light of the moon the three or four days centered about full moon. Others, while agreeing with this definition of dark of the moon, will insist that all the rest of the time is light of the moon. Still others, with equal assurance, will insist that the time the moon is waxing, that is, the time of the first and second quarters, is light of the moon, and that the time of its waning, the duration of the third and fourth quarters, is dark of the moon. Finally, there are many who recognize light of the moon to be all the days when the moon is above the horizon most of the fore part of the night, and all the rest of the time dark of the moon.

Here are three distinct and widely recognized definitions of dark of the moon, and four of the light of the moon. What then can the poor moon farmer do when up against such conflicting definitions as these? Nobody knows, though it is quite certain what he should do—forget the moon foolishness and plant when the ground is ready and the season right, as all sensible farmers do.

And these listed above are not the only weather words loosely used by the general public, whose omnibus excuse is the fact that, if restricted to correct understanding and clear expression, the pleasant glibness of its tongue would be lost in many a dreary silence—an honest enough excuse but a mighty poor one.

PALEONTOLOGY.—*An interesting occurrence of fossil tracks in West Virginia.*[1]

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Recently, through the generosity of Harold T. Stowell, of Westmoreland Hills, Md., the U. S. National Museum received a small slab of rock exhibiting two distinctly impressed tracks. The following brief report on the specimen is prompted by the probable tetrapod nature of the prints and by the geologic details of its occurrence.

The prints are impressed upon the upper undulating surface of a thin block of dense, finely grained sandstone, composed of many small cross-bedded laminae of variegated red and buff color. As found by Mr. Stowell in 1939, the slab lay loose at the base of a cliff on the East Bank of the Greenbrier River, about 1 mile south of the mouth of Island Lick Run, in the Watoga State Park, Pocahontas County, W. Va.

The physical expression of fossil trackways is dependent on a number of variable conditions. Seldom are the remains of the causative agent found associated with the prints. The structure of the contributing organ, therefore, must be inferred. This latter is very often difficult because the

[1] Published by permission of the Secretary of the Smithsonian Institution. Received December 5, 1947.

completeness of the impression is subject, at the time the tracks were made, to the composition and the consistency of the substratum and, subsequently, to all the multiple, special factors for their preservation. The interpretation of the present examples is not exempted from these general difficulties.

The two tracks, oriented parallel to each other, are each composed of the depressions made by three, stout, distally tapering digits. When the block is placed with the divergent extremities of the impressions directed away from the observer (Fig. 1), it may be seen that the track on the left is more deeply impressed and is situated slightly above the one on the right.

From the similar lengths and practically identical angles of divergence of the corresponding digital impressions in each of the two tracks, it is conceivable that the prints could have been made by one and the same appendage of an animal crossing the photograph transversely. In this latter event, however, the limb would seem necessarily to have extended out at a right angle to the longitudinal axis of the body with little or no anterior flexure. The literature on fossil trackways fails to reveal the occurrence of such a structural condition in the Late Paleozoic. Further in opposition to such an interpretation is the fact that the distance between the two prints would represent an extremely short stride, especially when the slab is large enough transversely to exhibit both preceding and succeeding impressions.

During the tetrapod propulsive cycle (Schaeffer, 1941; Evans, 1946), the body weight, first distributed over the entire surface of either the hand or foot, progressively

Fig. 1.—Photograph of fossil tracks (U.S.N.M. no. 17656) obtained in the Watoga State Park, Pocahontas County, W. Va. Reproduction approx. ×3/5.

shifts to a final concentration on the medial digits. While variable (Colbert and Schaeffer, 1947), this action ideally results in a deeper impression of the inner side of the organ than any other of its parts. The sides of the present fossil footprints, which are adjacent to each other, are clearly more deeply impressed than their distant sides. Thus, while the evidences are conflicting, it is here assumed that these tracks were made by a limb and its complement from the opposite side. Whether that pair of appendages was anterior or posterior can not be ascertained.

Markings of the pads of either heel or palm are not discernible. Impression of the digits alone indicates that the tracks were made on a fairly firm substratum. As pointed out by Colbert and Schaeffer (1947), the lateral digits are structurally the most divergent and under the least optimum of conditions are the most poorly defined in trackways. Thus, while 3-toed impressions have been encountered in practically every known geologic occurrence of tetrapod tracks, it remains uncertain whether complete impressions are being dealt with in the present case. No attempt here is made to assign these prints to any of the scientific names available because of the above mentioned uncertainties of interpretation and because of the questionable advisability of such practice. The specimen is no less interesting for this failure, however, because an early and unknown animal of considerable dimensions is indicated. The better preserved left imprint measures roughly 35 mm across the proximal base of the digits. The distance between parallel lines projected through the medial borders of the prints approaches 62 mm.

The block of sandstone bearing the impressions may be assumed to have been derived at or very near the site of its discovery. No evidences of transportation can be observed. The edges of the slab remain sharply angular. Fragments of soft red shale still adhere in the concavities on both its upper and lower surfaces. Furthermore, its lithology is identical with that of the bedrock exposed in the immediate vicinity as well as for many miles upstream. Price (1929) identifies this rock as the Pocono formation. As summarized by Branson (1910) and Colbert and Schaeffer (1947), the oldest previous reports of definitive tetrapod tracks in the United States are restricted to the upper Mississippian Chester Series. The literature (Butts, 1940; Chadwick, 1935; Willard, 1936) suggests a transgressive character to the Pocono sediments and a consequent variation in age from place to place. Notwithstanding, the Pocono is well below the Chester equivalent, the Mauch Chunk, in the West Virginia section. The present occurrence, therefore, seems to be the earliest yet known from our country and approaches in age the oldest authenticated tetrapod tracks from the Horton Series of Nova Scotia (Dawson, 1894; Sternberg, 1933).

REFERENCES

Branson, E. B. *Amphibian footprints from the Mississippian of Virginia.* Journ. Geol. **18**(4): 356–358, 1 fig. 1910.

Butts, Charles. *Geology of the Appalachian Valley in Virginia. Pt. 1: Geologic text and illustrations.* Virginia Geol. Surv. Bull. 52: i–xxxii, 1–568, 10 figs. incl. index and geol. sketch maps, 10 tables, 63 pls. 1940.

Chadwick, G. H. *What is "Pocono"?* Amer. Journ. Sci., ser. 5, **29**(170): 133–143, map. 1935.

Colbert, E. H., and Schaeffer, B. *Some Mississippian footprints from Indiana.* Amer. Journ. Sci. **245**(10): 614–623, 1 fig., 1 pl. 1947.

Dawson, W. *Synopsis of the air-breathing animals of the Paleozoic in Canada, up to 1894.* Trans. Roy. Soc. Canada **12**(4): 71–88. 1894.

Evans, F. G. *The anatomy and function of the foreleg in salamander locomotion.* Anat. Rec. **95**: 257–281, 6 figs. 1946.

Price, P. H. *Pocahontas County.* West Virginia Geol. Surv. County Repts.: 531, 21 figs., 71 pls., 2 maps. 1929.

Schaeffer, B. *The morphological and functional evolution of the tarsus in amphibians and reptiles.* Bull. Amer. Mus. Nat. Hist. **78**(6): 395–472, 21 figs. 1941.

Sternberg, C. M. *Carboniferous tracks from Nova Scotia.* Geol. Soc. Amer. Bull. **44**: 951–964, 1 fig., 3 pls. 1933.

Willard, B. *Continental upper Devonian of northeastern Pennsylvania.* Geol. Soc. Amer. Bull. **47**(4): 597–599, 3 figs., 3 pls. 1936.